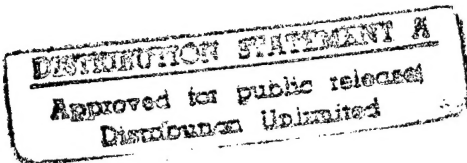


Energy Engineering Analysis Program (EEAP)
Limited Energy Study - *LIGHTING*
Fort Campbell, Kentucky

Final Report

Executive Summary



CONTRACT #DACA27-01-94-D-0034
SYSTEMS CORP PROJECT #94013.01
SEPTEMBER 23, 1994



Louisville District
US Army Corp
of Engineers

SYSTEMS*corp*

SYSTEMS ENGINEERING AND MANAGEMENT CORPORATION




DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
P.O. BOX 9005
CHAMPAIGN, ILLINOIS 61826-9005

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Marie Wakefield,
Librarian Engineering

1 EXECUTIVE SUMMARY

FY94 EEAP LIGHTING ENERGY STUDY, FT. CAMPBELL, KY

1.1 SYNOPSIS

Systems Corp surveyed and completed energy analyses for 95 representative buildings at Fort Campbell, categorized as Korean War Barracks, Airfield Buildings, and Blanchfield Hospital buildings B and C. The energy conservation opportunities (ECOs) evaluated were high efficiency interior and exterior lighting, and indoor lighting controls. Cost estimates were prepared using MeansData for Windows Spreadsheets, Version 2.0a. Life cycle cost analyses were performed using the Life Cycle Cost in Design (LCCID) computer program. Project development brochures (PDBs) and DD1391 forms were prepared for four Energy Conservation Investment Program (ECIP) projects. The total of the four projects that were developed represent \$385,283 in annual savings with a simple payback of 6.37 years and a saving to investment ratio (SIR) of 1.89.

1.2 INTRODUCTION

Systems Engineering and Management Corporation (Systems/Corp) was contracted by the Louisville District of the United States Army Corps of Engineers in June 1994 to perform a limited energy study for 95 buildings at Fort Campbell, Kentucky. The project includes a study of interior and exterior lighting, as well as controls.

1.2.1 Scope of Work

1. Evaluate selected energy conservation opportunities (ECOs) to determine their energy savings potential and economic feasibility.
2. Conduct a limited site survey of selected buildings or areas to insure that any methods of energy conservation which are practical and have not been evaluated in any previous energy study have been considered and the results documented.
3. Determine efficiency of existing systems. Determine the replacement option with the highest SIR.
4. Provide complete programming or implementation documentation for all recommended ECOs.
5. Prepare a comprehensive report to document the work performed, the results, and the recommendations.

DTIC QUALITY INSPECTED 2

1 EXECUTIVE SUMMARY

FY94 EEAP LIGHTING ENERGY STUDY, FT. CAMPBELL, KY

1.2.2 Organization of the Final Report

The submitted material for this report consists of the following:

Volume I: Executive Summary, Methods and Approach, Project I: Interior/Exterior Lighting at Airfield, Project II: Lighting Controls at Airfield, Project III: Interior Lighting and Controls at Blanchfield Hospital, Project IV: Interior Lighting at Korean War Barracks

Volume II: Scope of Work, Interim Review Comments and Responses, and Interim Review Presentation

1.3 PRESENT AND HISTORICAL ELECTRICAL ENERGY CONSUMPTION

The baseline energy consumptions and the energy conservation opportunity energy consumption were determined using spreadsheets and manual calculating to model system energy consumption. These have been included in *Section 2* of this report.

The electric energy consumption, demand, and total costs for FY93 are shown in *Table 1.3.1 Fort Campbell Electric*. *Figure 1.3.1* is a bar graph of the monthly consumption and cost for FY93. The electric costs used to calculate the electric cost savings for the project are as follows:

COST/kWh	=	\$0.02114/kWh (No Demand)
COST/MBtu	=	\$6.18/MBtu (No Demand)
COST/kW	=	\$11.78/kW (Monthly Demand)

1.4 ENERGY CONSERVATION OPPORTUNITIES INVESTIGATED

Systems Corp analyzed two energy conservation opportunities (ECOs) at Fort Campbell, Kentucky. The analysis was performed utilizing energy models developed by Systems Corp and data collected during the field survey of the facilities at Fort Campbell. Each ECO was evaluated to determine the potential energy savings, dollar savings, implementation costs, simple payback, life cycle cost, and savings to investment ratio (SIR). The two ECOs that were evaluated are as follows:

ECO - 1 High Efficiency Interior/Exterior Lighting

ECO - 2 Lighting Controls

Table 1.3.1

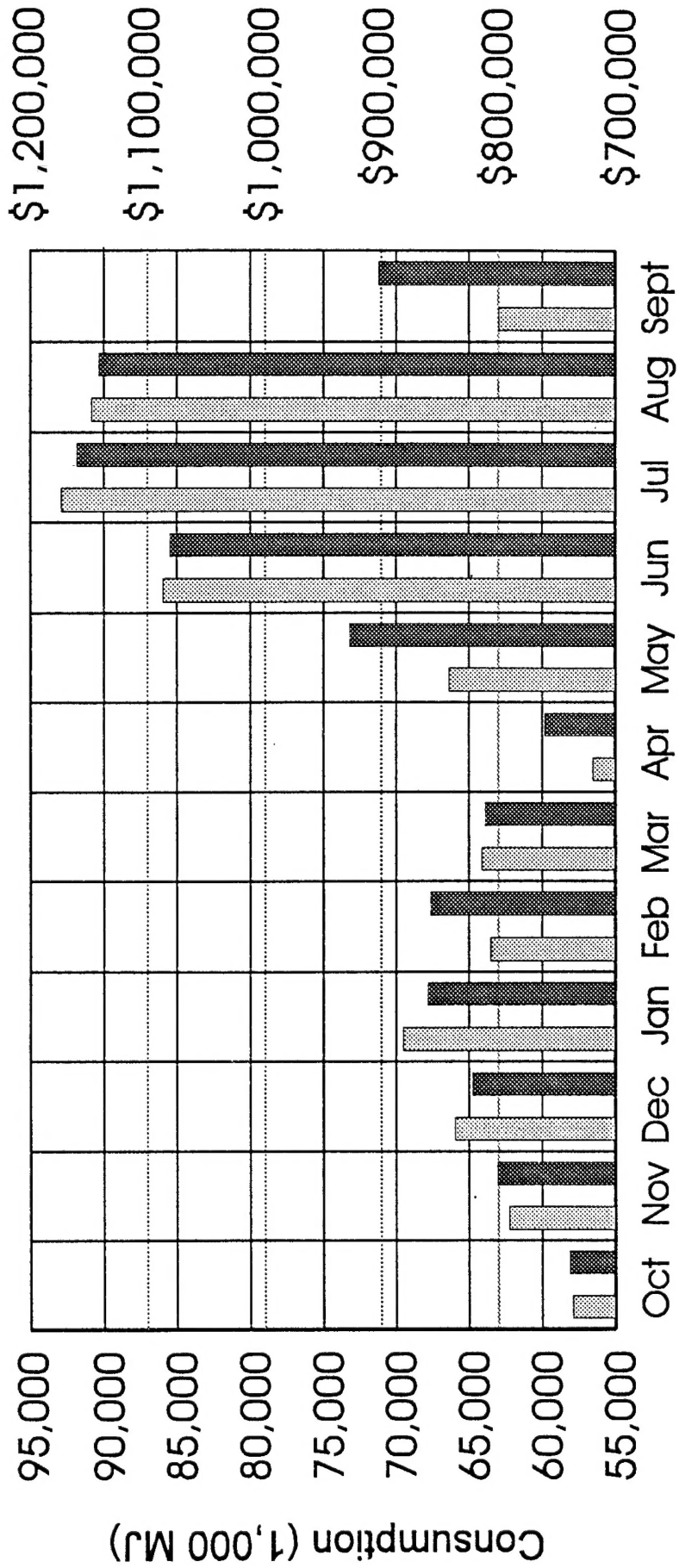
Fort Campbell Electric

FY93

Month	Demand (KW)	Consumption (KWH)	Total Cost	Cost/KWH
Oct '92	31,072	16,077,600	\$739,346	\$0.046
Nov	34,020	17,287,200	\$800,806	\$0.046
Dec	33,907	18,320,400	\$821,704	\$0.045
Jan '93	35,381	19,307,400	\$860,667	\$0.046
Feb	38,140	17,644,200	\$857,977	\$0.049
Mar	33,944	17,808,000	\$811,111	\$0.046
Apr	34,663	15,691,200	\$760,262	\$0.048
May	43,697	18,429,600	\$926,917	\$0.050
Jun	47,212	23,872,800	\$1,081,048	\$0.045
Jul	50,009	25,800,600	\$1,160,394	\$0.045
Aug	49,556	25,229,400	\$1,141,714	\$0.045
Sep	43,281	17,488,800	\$902,293	\$0.052
TOTAL	474,882	232,957,200	\$10,864,239	\$0.047
Min	31,072	15,691,200	\$739,346	\$0.045
Max	50,009	25,800,600	\$1,160,394	\$0.052
Avg	39,574	19,413,100	\$905,353	\$0.047

Figure 1.3.1 Fort Campbell Electric

FY93



Consumption (1,000 MJ) Cost (\$)

1 EXECUTIVE SUMMARY

FY94 EEAP LIGHTING ENERGY STUDY, FT. CAMPBELL, KY

Systems Corp's energy analysis models were used to determine the savings achieved for implementing each ECO in the facilities that were evaluated. MeansData for Windows Spreadsheets, Version 2.0a cost estimating software was used to estimate the implementation cost of each ECO in each facility evaluated. The U.S. Army Corps of Engineers' Life Cycle Cost in Design, Version 1.0, Level 80, software was used to perform life cycle cost analyses and determine the SIR of each ECO for each facility evaluated.

1.4.1 ECOs Recommended

Systems Corp recommended that both of the ECOs evaluated be implemented, but not in every area surveyed. The following is a list of the ECOs recommended to be implemented by area surveyed. The criteria for recommendation is a favorable simple payback and savings to investment ratio (SIR).

ECO - 1: Airfield Buildings
Blanchfield Hospital
Korean War Barracks

ECO - 2: Airfield Buildings
Blanchfield Hospital

1.4.2 ECOs Rejected

ECO-2, Lighting Controls, in the Korean War Barracks was rejected due to the large investment required for the proper controls set-up. The best opportunity for lighting controls was in the latrine areas. Due to multiple walls and sections, multiple overhead occupancy sensors would be required. Good energy savings were available, but the high investment costs gave the project a poor simple payback and SIR.

1.4.3 ECIP Projects Developed

Systems Corp developed four ECIP/FEMP projects. The projects included interior/exterior lighting in 28 buildings at the Airfield, lighting controls in 15 buildings at the Airfield, interior lighting and controls at Blanchfield Hospital, and interior lighting at 44 Korean War Barracks. The following table summarizes the savings and investments for each project.

TABLE 1.4.3
FORT CAMPBELL LIGHTING ENERGY STUDY
ECIP PROJECT SUMMARY

PROJECT NUMBER	DESCRIPTION	1ST YEAR SAVINGS	TOTAL INVESTMENT	SPB (YRS)	SIR	MBTU Annual Energy Savings
1	INTERIOR LIGHTING AT AIRFIELD (ECO 1)	\$130,656	\$709,900	5.43	2.21	6,521
2	LIGHTING CONTROLS AT AIRFIELD (ECO 2)	\$26,209	\$60,078	2.29	5.21	634
3	INTERIOR LIGHTING AND LIGHTING CONTROLS AT HOSPITAL (ECO 1 & 2)	\$79,518	\$424,003	5.33	2.27	5,256
4	INTERIOR LIGHTING AT KOREAN WAR BARRACKS (ECO 1)	\$148,900	\$1,260,715	8.47	1.43	9,279
PROJECT TOTALS		\$385,283	\$2,454,696	6.37	1.89	21,690

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4. PROJECT TITLE INTERIOR/EXTERIOR LIGHTING REPLACEMENT AT ARMY AIRFIELD		5. PROJECT NUMBER ECIP #1									
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1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA	2. DATE 23 September 94
3. INSTALLATION AND LOCATION Fort Campbell, Kentucky		
4. PROJECT TITLE LIGHTING CONTROLS AT AIRFIELD		5. PROJECT NUMBER ECIP #2

Life Cycle Cost Analysis
Project Title: Lighting Controls at Airfield
Fiscal Year: 1994
Analysis Date 09/23/94
Economic Life: Fifteen (15) Years

1. INVESTMENT

A. CONSTRUCTION COST	54,616
B. SIOH	2,731
C. DESIGN COST	2,731
D. ENERGY CREDIT CALC	-0-
E. SALVAGE VALUE	-0-
F. TOTAL INVESTMENT	\$60,078

2. ENERGY SAVINGS
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	COST \$/MBtu (1)	SAVINGS MBtu/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	6.18	634	3,921	12.43	48,738
B. DIST					
C. RESID					
D. NG					
E. DEMAND			22,288	11.85	264,113
F. TOTAL		634	26,209		312,851

3. NON-ENERGY SAVINGS

A. ANNUAL RECURRING (1)DISCOUNT FACTOR	11.85	\$0
B. NON-RECURRING SAVINGS		\$0

ITEM	SAVINGS (+) COST(-)(1)	YEAR OF OCCURRENCE (2)	DISCOUNT FACTOR (2)	DISCOUNTED SAVINGS(+) COST (-)(4)
a. Replace Interior				
b. Replace Exterior				
c.				
d. Total				

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (+)/COST(-) 0

1. COMPONENT ARMY	FY 19 <u>94</u> MILITARY CONSTRUCTION PROJECT DATA		2. DATE 23 September 94
3. INSTALLATION AND LOCATION Fort Campbell, Kentucky			
4. PROJECT TITLE LIGHTING CONTROLS AT AIRFIELD		5. PROJECT NUMBER ECIP #2	
SPECIAL REQUIREMENTS PARAGRAPH 1 (SRP-1) (continued)			
4. FIRST YEAR DOLLAR SAVINGS		\$ 26,209	
5. SIMPLE PAYBACK PERIOD		2.29 Years	
6. TOTAL NET DISCOUNTED SAVINGS		\$312,851	
7. DISCOUNTED SAVINGS RATIO		5.21	

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A. ANNUAL RECURRING					\$6062																																																																																																				
(1)DISCOUNT FACTOR		11.85																																																																																																							
(2)DISCOUNTED SAVINGS					\$71,835																																																																																																				
B. NON-RECURRING SAVINGS																																																																																																									
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<p>Life Cycle Cost Analysis Project Title: Interior Lighting Replacements Fiscal Year: 1994 Analysis Date 09/23/94 Economic Life: Fifteen (15) Years</p> <p>1. INVESTMENT</p> <table style="width: 100%;"> <tr> <td style="width: 60%;">A. CONSTRUCTION COST</td> <td style="text-align: right;">1,146,105</td> </tr> <tr> <td>B. SIOH</td> <td style="text-align: right;">57,305</td> </tr> <tr> <td>C. DESIGN COST</td> <td style="text-align: right;">57,305</td> </tr> <tr> <td>D. ENERGY CREDIT CALC</td> <td style="text-align: right;">-0-</td> </tr> <tr> <td>E. SALVAGE VALUE</td> <td style="text-align: right;">-0-</td> </tr> <tr> <td>F. TOTAL INVESTMENT</td> <td style="text-align: right;">1,260,715</td> </tr> </table> <p>2. ENERGY SAVINGS ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS</p> <table style="width: 100%;"> <thead> <tr> <th style="text-align: left;">FUEL</th> <th style="text-align: center;">COST \$/MBtu (1)</th> <th style="text-align: center;">SAVINGS MBtu/YR(2)</th> <th style="text-align: center;">ANNUAL \$ SAVINGS(3)</th> <th style="text-align: center;">DISCOUNT FACTOR(4)</th> <th style="text-align: center;">DISCOUNTED SAVINGS(5)</th> </tr> </thead> <tbody> <tr> <td>A. ELECT</td> <td style="text-align: center;">6.18</td> <td style="text-align: center;">9,279</td> <td style="text-align: center;">57,344</td> <td style="text-align: center;">12.43</td> <td style="text-align: center;">\$712,789</td> </tr> <tr> <td>B. DIST</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>C. RESID</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>D. NG</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>E. DEMAND</td> <td></td> <td></td> <td style="text-align: center;">67,540</td> <td style="text-align: center;">11.85</td> <td style="text-align: center;">800,349</td> </tr> <tr> <td>F. TOTAL</td> <td></td> <td style="text-align: center;">9,279</td> <td style="text-align: center;">124,884</td> <td></td> <td style="text-align: center;">1,513,138</td> </tr> </tbody> </table> <p>3. NON-ENERGY SAVINGS</p> <table style="width: 100%;"> <tr> <td style="width: 50%;">A. ANNUAL RECURRING (1)DISCOUNT FACTOR</td> <td style="text-align: center;">11.85</td> <td style="text-align: right;">\$24,016</td> </tr> <tr> <td>B. NON-RECURRING SAVINGS</td> <td></td> <td style="text-align: right;">\$284,590</td> </tr> </table> <table style="width: 100%; margin-top: 10px;"> <thead> <tr> <th style="text-align: left;">ITEM</th> <th style="text-align: center;">SAVINGS (+) COST (-)(1)</th> <th style="text-align: center;">YEAR OF OCCURRENCE (2)</th> <th style="text-align: center;">DISCOUNT FACTOR (2)</th> <th style="text-align: center;">DISCOUNTED SAVINGS(+) COST -(4)</th> </tr> </thead> <tbody> <tr> <td>a. Replace Interior</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>b. Replace Exterior</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>c.</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>d. Total</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p style="margin-top: 20px;">C. TOTAL NON ENERGY DISCOUNTED SAVINGS (+)/COST(-) 284,590</p>			A. CONSTRUCTION COST	1,146,105	B. SIOH	57,305	C. DESIGN COST	57,305	D. ENERGY CREDIT CALC	-0-	E. SALVAGE VALUE	-0-	F. TOTAL INVESTMENT	1,260,715	FUEL	COST \$/MBtu (1)	SAVINGS MBtu/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)	A. ELECT	6.18	9,279	57,344	12.43	\$712,789	B. DIST						C. RESID						D. NG						E. DEMAND			67,540	11.85	800,349	F. TOTAL		9,279	124,884		1,513,138	A. ANNUAL RECURRING (1)DISCOUNT FACTOR	11.85	\$24,016	B. NON-RECURRING SAVINGS		\$284,590	ITEM	SAVINGS (+) COST (-)(1)	YEAR OF OCCURRENCE (2)	DISCOUNT FACTOR (2)	DISCOUNTED SAVINGS(+) COST -(4)	a. Replace Interior					b. Replace Exterior					c.					d. Total				
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